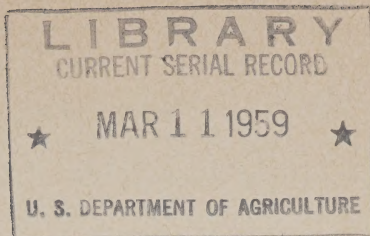


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## *Nursery Diseases of Southern Pines*

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Forest tree nurseries in the South produced over 500 million seedlings during the 1957-58 season, of which approximately 75 percent were slash pine, 20 percent loblolly pine, and 5 percent other species. As a regular procedure, all these millions of southern pines are grown for one season in the nursery beds and shipped as 1-0 stock. The increased demand for seedlings has caused many nurseries to change from alternate pine and cover cropping to continuous pine cropping, or to a rotation in which seedlings are grown in the same beds 2 years out of 3. Intensive cropping has necessitated the use of sawdust as a soil amendment to increase the organic content; heavy fertilization has also been needed to maintain nutrient levels. This intensive cropping has increased the likelihood of losses from some diseases.

### **Damping-Off**

The term "damping-off" refers to a group of symptoms caused by the attack of soil fungi during the first few weeks after planting. If the emerging radicle of the pine seedling is attacked, the injury is called pre-emergence damping-off, or seed decay. More frequently, however, the roots push into the soil and the seedlings emerge before fungi attack; then the fungi weaken the succulent stem tissue at or near the soil line, causing the seedlings to topple. This type of injury is called post-emergence damping-off. Fungus injury that results in decay of either taproots or fine roots is termed root rot. The fungi most commonly associated with early losses in the seedbed belong to the genera *Pythium*, *Rhizoctonia*, and *Fusarium*.

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Fortunately, most nursery soils have a pH of 5.5 or lower, which retards the development of damping-off fungi. Thus, losses from damping-off are rarely serious in southern nurseries.

High soil nitrogen at germination predisposes pine seedlings to fungus infections; consequently, nurserymen attempt to maintain low levels of nitrogen during this period. Sawdust as a soil amendment helps to regulate the availability of nitrogen.

Nitrogen fertilizers are generally applied before the cover crop 1 year before seeding pines, or as a side dressing after the seedlings are 1 month old. Cover crops and organic manures must be turned under at least 2 months before seeding.

Intense sunlight common in the South in spring favors rapid growth of pine. If seedbed densities are less than 40 seedlings per square foot and seed-covering materials less than  $\frac{1}{4}$  inch thick, the seedlings grow rapidly but remain stocky through the critical damping-off period.

Adequate moisture combined with good drainage of the surface soil results in optimum germination and growth without favoring disease organisms. Conversely, excess moisture and poor soil drainage have been associated with severe seedling losses in some nurseries. A minimum soil temperature of 60 degrees F. at a depth of 6 inches is needed to keep the seedlings growing rapidly.

Where conditions of high pH, excessive soil moisture, and low

temperature favor damping-off, it is occasionally necessary to use chemicals to control the disease. Dusting the seeds with captan or thiram at the rate of 1 pound per 100 pounds of seed has given control in some tests. Soil acidification and chemical seed treatments commonly used in northern nurseries are not generally needed under southern conditions.

Fumigation of the soil with methyl bromide before planting will also control damping-off. Losses from damping-off diseases in southern nurseries, however, are rarely sufficiently serious to warrant the expense of fumigation. The post-emergence stage of damping-off can be controlled with drenches of captan or thiram. These materials are effective only when applied in large volumes of water—a minimum of 600 gallons per acre. Such procedures are too expensive to be practical under usual southern conditions.

Whitish lesions above the soil line caused by sunscald are often confused with damping-off. They usually occur on seedlings from late sowings or in seedbeds where the seed cover has been too thick.

### **Black Root Rot**

After the seedlings are about 2 months old, other soil micro-organisms may attack the roots, producing what is called black root rot. The lateral roots may be completely destroyed. The outer cells of the taproot turn black and can be stripped off with the finger. There is often an enlargement of new



lateral roots above the dead portion of the taproot, and reddish-black, rough, swollen cankers appear on the living roots. Sometimes small reddish pustules of cortical root cells break through the bark.

Two soil fungi, *Sclerotium bataticola* and *Fusarium oxysporum*, combine to produce symptoms of black root rot. The *Fusarium* more commonly causes the decay of lateral roots, while the *Sclerotium* grows on the surface of the main roots causing swollen lesions. *Sclerotium* does not penetrate the roots but produces a chemical that causes the cortical root cells to multiply abnormally. Other soil fungi may sometimes also be involved.

The most successful method of combating black root rot is fumigation of the soil with methyl bromide before planting (fig. 1). The soil is harrowed or rototilled and watered to a moisture content suitable for planting. The chemical is applied at a rate of 1 pound per 150 square feet under polyethylene plastic sheets when the soil temperature is above 60 degrees F. at a depth of 6 inches. Sacks of pine straw are placed in the center of the area under the sheets to raise the cover so as to allow the gas fumes to spread uniformly over the area. Twenty-four hours after the chemical has been applied, the plastic sheets are removed.

Methyl bromide kills weed seeds, fungi, insects, nematodes, and other soil organisms and has an additional beneficial effect on plant growth, but the reason is not clearly understood. The cost of the appli-

cation and chemical is less than \$300 per acre. Nurserymen who have used methyl bromide have found that most of the beneficial effects last at least 3 years. By spreading the cost of treatment over 3 crops, the cost per thousand seedlings is less than 10 cents. Other soil fungicides have been tested for control of black root rot, but to date none has equaled methyl bromide in efficiency or consistency.

### Nematode Injury

In their feeding, nematodes damage pine seedlings by puncturing the roots; these punctures also provide entrance points for pathogenic soil micro-organisms. Species of *Meloidodera* and *Xiphinema* and two species of *Tylenchorhynchus* are known to feed directly on roots of nursery-grown pine seedlings in the South. Other nematodes can also be damaging.

Ethylene dibromide applied at the rate of 15 gallons of 85-percent concentrate per acre effectively kills nematodes. In some nurseries it has given satisfactory control of root rot for one season, when nematodes have been active. Dichloropropene mixtures are used in some nurseries and other nematocides might be equally effective.

### Fusiform Rust

Throughout the Coastal Plain and Piedmont of the South, the fungus *Cronartium fusiforme* is a serious threat to the production of slash and loblolly pine seedlings. During April, May, and early June, brown hairlike telia are produced on





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Figure 1.—A, Unfumigated bed of 1-0 slash pine in a Georgia nursery; seedlings small and root rotted. B, Neighboring bed fumigated with methyl bromide before planting; seedlings large and free of black root rot.





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Figure 2.—A group of slash pine seedlings with stem swellings caused by fusiform rust, at the end of 1 year in the nursery.

the undersides of the new leaves of several species of oaks. These telia produce spores, which are carried by the wind to pine seedlings. Infection of the needles or soft stem tissue occurs only when the atmosphere is near saturation for an 18-hour period, and temperatures are between 60 and 80 degrees F. In the following September or October, spindle-shaped swellings appear on the stems of infected seedlings. These swellings indicate that the seedlings will be stunted, deformed, or killed (fig. 2).

Fusiform rust infections can be prevented by sprays of ferbam, ziram, or zineb prior to infection. Complete coverage of all seedling tissue is essential. Two pounds of ferbam, ziram, or zineb per 75 gal-

lons of spray per acre are commonly used with high-pressure sprayers. A spreader-sticker is usually added to improve coverage and reduce weathering.

Concentrate sprayers have recently been introduced. By substituting an air blast for part of the water, these sprayers or mist blowers use a lower volume of water to apply the same amount of chemical. They cover strips 40 to 50 feet in width, applying 35 gallons per acre. These sprayers are of value in the large nurseries where conventional high-pressure sprayers cannot cover the area rapidly enough during rainy periods to prevent infection.

Most nurserymen spray weekly from the time of seed germination



to the middle of June and twice a week during severe infection periods when seedlings are growing fast. Prescription spraying is possible by studying weather conditions and examining nearby oak leaves. The number of spray applications can be reduced one-half or more by spraying only when rains or fogs are expected for an 18-hour period at temperatures between 60 and 80 degrees F., and when spores are being produced on oak leaves. A combination of all three of these factors is necessary for a serious amount of infection.

All the obviously diseased seedlings should be culled at lifting time. Rust-infected seedlings have swollen stems near the ground line.

### Brown Spot

Longleaf pine in nurseries near the Gulf of Mexico is commonly diseased by brown spot. The causal fungus, *Scirrhia acicola*, penetrates the needles and causes brown spots with or without a yellow band on either side. Heavy infection may defoliate seedlings.

The disease can be controlled by spraying with a 4-4-50 bordeaux mixture prepared by dissolving 4 pounds of copper sulfate in 50 gallons of water. Four pounds of hydrated lime are stirred into a bucket of water, and the suspension added to the copper sulfate solution while the contents of the spray tank are thoroughly agitated. The mixture is applied at the rate of 60 gallons per acre, at 300 pounds pressure. Sprays are applied at 10-day to 30-day intervals, from

the middle of June until the end of October in areas where brown spot is a problem. Spray schedules vary with the amount of rainfall, but four to six applications are usually adequate. Other fungicides, such as fixed coppers and ferbam, have been used for control of this disease. Research on additional fungicides for use against brown spot is under way.

### Chlorosis

During July and August, high temperatures may turn the needles of seedling pine yellow. This condition may be severe enough to cause stunting of the seedlings, or even death, but normal coloring usually reappears in the fall with no obvious damage.

When the needles of pine turn light green, the color can often be restored by a top dressing of urea, ammonium nitrate, or diammonium phosphate at the rate of 50 pounds of nitrogen per acre. Seedlings that develop a creamy yellow color in irregular areas along the edges of beds in midsummer do not respond to nitrogen fertilization. Additional nitrogen has been observed to accentuate yellowing. Sometimes iron chelates used at the rate of 3 pounds of metallic iron per acre have reduced these symptoms, but at other times neither nitrogen nor iron will control the trouble.

The effect of high soil temperatures on soil aeration, excessive soil moisture, soil micro-organisms, and chlorophyll destruction caused by high needle temperatures are possible causes of some summer yellow-



ing. No practical control is known for this type of chlorosis.

Seedlings from seed planted early in the spring and well fertilized throughout the growing season usually survive summer chlorosis and develop into marketable plants.

**Caution:** Captan, ferbam, thiram, ziram, methyl bromide, ethylene dibromide, dichloropropene, and copper sulfate are poisons. In handling them follow the directions carefully and heed the precautions given on the container.



